Space Weather Technical Forecast

Issued on Friday, 26 January 2024 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Potential for CME glancing blow arrivals today, with a slight chance of G1/Minor Storm. Chance of Moderate solar activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with two C9 flares observed, with the first at 26/0033 UTC and the second occurred at 26/0459 UTC, both originated from AR3561 in the southwest quadrant, which is now close to the limb. There are currently four numbered sunspot regions on the visible disc, with a new and unnumbered region, which has emerged in the eastern hemisphere. AR3561 and AR3559 are the two largest and most complex regions. AR3561 in the southwest appears to be undergoing some minor decay in areal extent, although this could be due to its increasing proximity to the limb, which is making assessing the magnetic structure more difficult. However, this region has produced the majority of the C-class flares over the past 24 hours. AR3559 in the northwest previously had a large delta region, but has simplified over the past 24 hours, although will continue to be monitored for any new developments. AR3555 is situated very close to AR3561 which makes it difficult to determine the separation, and these could be considered one region. The remaining spot regions are small and simple. There have been several CMEs emerge in the past 24 hours, although none of these appear to be Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by ACE and DSCOVR, showed a weak CME arrival around 25/1357 UTC. Wind speeds have been predominately slightly elevated, ranging between 380-460km/s. Density started below average but gradually increased to generally average levels. Total magnetic field strength was predominantly weak at 7nT or below, but increased through the afternoon to peak at 10 nT at 25/1435 UTC. Bz varied weakly between -7 to +7nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet throughout (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels.

GOES16 high energy (greater than 2MeV) electron flux was predominantly at background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a steady trend. At 26/0000UTC the 24-hour integrated fluence observation was 1.23e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity has declined over the past few days, but is expected to be Low to Moderate with a chance of isolated M-flares and a slight chance of an X-flare.

Solar Wind / Geomagnetic Activity: There is potential for the arrival of glancing blows from numerous CMEs during day 1 (26 Jan). Overall, geomagnetic activity is expected to be mostly Quiet to Unsettled, with the slight chance of Active to G1/Minor Storm interval should any CMEs

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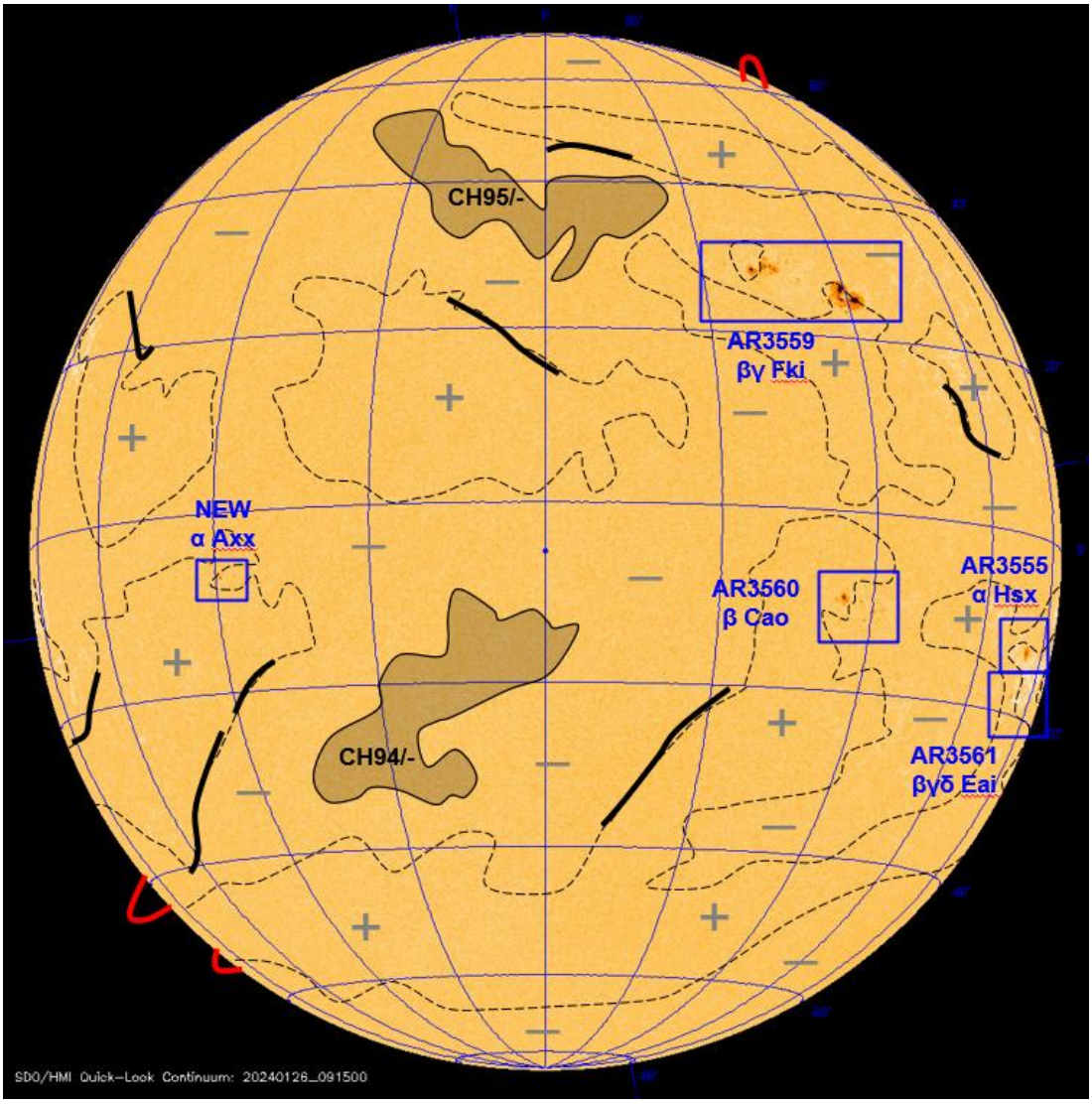
arrive during Day 1 (26 Jan). Geomagnetic activity should then return to mostly Quiet on Days 2-3 (27-28 Jan) after any residual CME effects have waned. During day 4 (29 Jan) a coronal hole high speed stream is expected to arrive, and geomagnetic activity is expected to increase to Unsettled to Active levels, with a slight chance of a G1/Minor Storm.

Energetic Particles / Solar Radiation: There is a slight chance of radiation storms throughout, due to both AR3559 and AR3561 located on the western limb.

The high energy electron (greater than 2MeV) flux may rise later in the period, especially with the expected arrival of a HSS. There is a slight chance of electron fluence exceeding Active (1e8 integrated pfu), increasing to a Chance for day 4 (29th). However, confidence is low regarding this.

Figure 1. Solar Analysis Valid 26/0915 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

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There have been numerous CMEs observed over recent days. The majority of these are expected to miss Earth, although there was the potential for glancing blows in the forecast period. We are still awaiting the potential arrival of glancing CMEs, most of which left the Sun on the 22-23 Jan. However, there were some minor disturbances in the solar wind parameters on 25 Jan, which may have been weak transient features glancing Earth, as a result no significant geomagnetic activity was observed, which was Quiet throughout. There is still the potential for glancing blows from CMEs on Day 1 (26 Jan) although any impacts are now likely to be limited. Overall confidence is low regarding any CME arrivals.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, with a slight chance of increasing to Active or G1/Minor Storm intervals, if any CMEs arrive during Day 1 (26 Jan). Geomagnetic activity should then be mostly Quiet on Days 2-3 (27-28 Jan) after any residual CME effects have waned. During day 4 (29 Jan) a coronal hole high speed stream is expected to arrive, most likely from CH94 late in the day, although there is a chance of a weak connection to CH95 earlier in day 4 as CH95 is extends slightly further west than CH94 but is also much further north. With a HSS connection during day 4 (29 Jan) geomagnetic activity is expected to increase to Unsettled to Active levels, with a slight chance of a G1/Minor Storm.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	10	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL shows potential arrival of CMEs – although these are now considered to be overdue. Possible glancing blows during day 1 (26 Jan) – low confidence.

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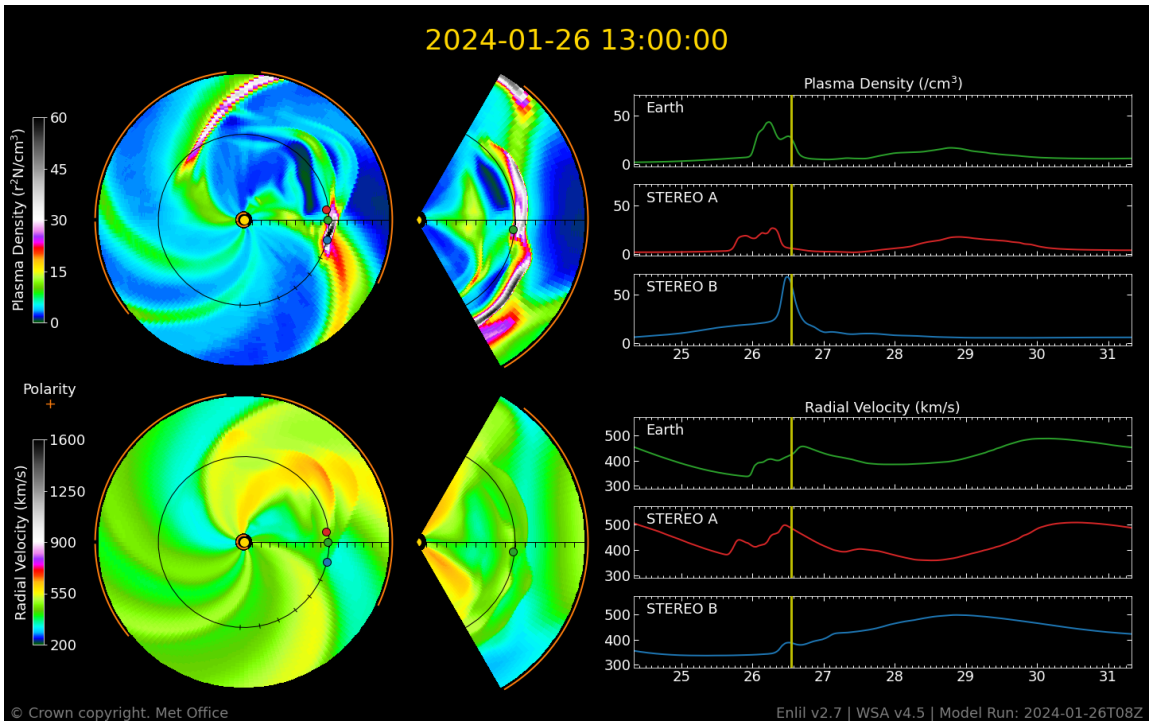

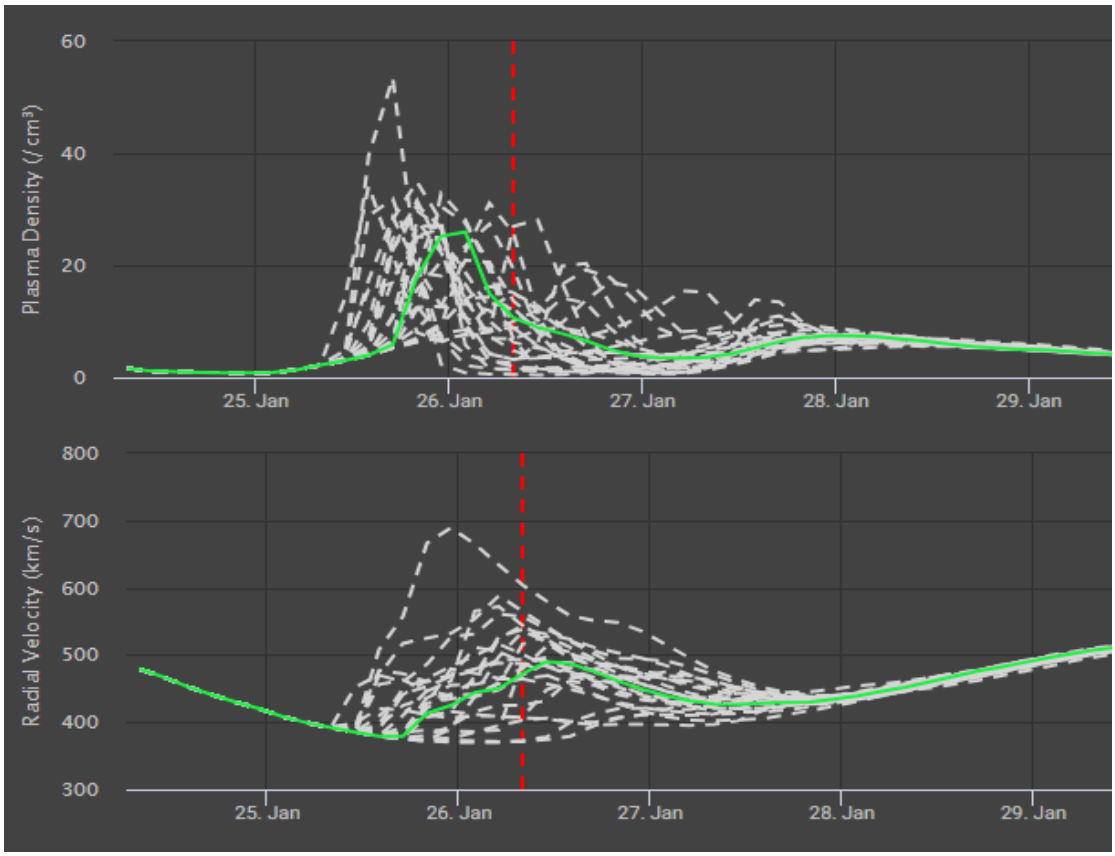

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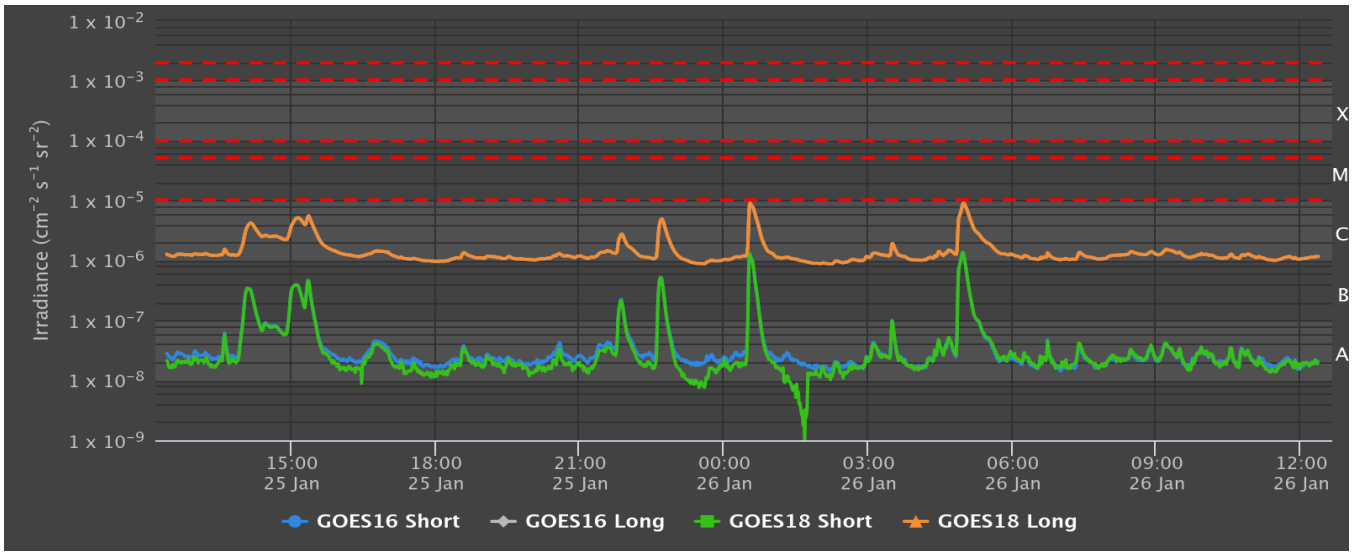
Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the past 24 hours, with only two C9 flares observed, both from AR3561, which is close to the southwest limb.

There are currently four numbered sunspot regions on the visible disc, with one new and unnumbered region, which has recently emerged in the eastern hemisphere. AR3561 and AR3559 remain the two largest and most complex regions. AR3561 in the southwest appears to have recently shown some minor decay in areal extent. However, this could be due to AR3561's approach to the limb, which is increasingly making assessing the magnetic structure more difficult. Therefore the previously classification of Eai/beta-gamma-delta has been maintained. AR3559 in the northwest is the largest region on the disc, which has recently lost its 'delta' spot on the trailing large spot. However, continuing to keep a close eye on this region, as it appears some penumbra is re-emerging within the vicinity of large spot, where the delta spot may re-appear. AR3555 is situated very close to AR3561 which makes it difficult to determine the separation, and these could be considered one region. AR3556 has now faded. The remaining spot regions are small and simple at present. There appears to be two areas of plage rotating round the east limb, where potential new sunspot regions could emerge.

Activity has declined over past few days, but is expected to be Low to Moderate with a chance of isolated M-flares and a slight chance of an X-flare. These most likely from AR3559 and AR3561, but also potentially from new regions that are likely to imminently rotate onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	45	45	45	45
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES18 X-Ray trace



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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is at background levels.

There is a slight chance of radiation storms throughout due to both AR3559 and AR3561 being located in the western hemisphere. Both of these regions are magnetically complex, with a risk of an increase in proton flux should they produce any larger flares. However, AR3561 rotates off behind the visible disc tomorrow, and therefore the probabilities of a radiation storm decrease later in the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron (greater than 2MeV) flux is most likely to remain at background levels for much of this period. Towards the end of the period, any waning CME effects could see electron flux begin to rise. A rise in the high energy electron flux could be aided by the potential arrival of a HSS through day 4 (29th), most likely from CH94 but possibly from CH95 as well. Electron fluence is expected to stay below Active (1e8 integrated pfu), although with a rising trend late in the period. REFM is currently providing a good guidance, keeping the fluence well below the Active threshold. However, a slightly increasing trend is preferred over the next 3 days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	15	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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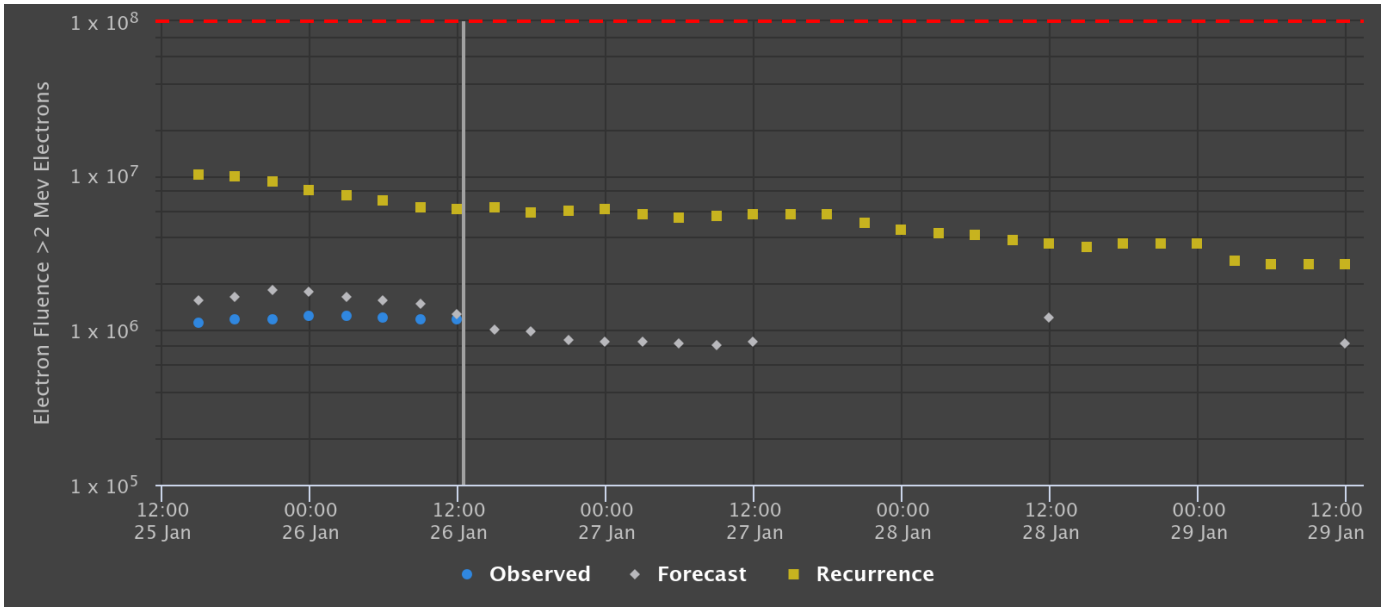
Figure 4: MOSWOC REFM electron fluence



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